

Patent claims

1. A catheter for the aspiration, fragmentation and removal of removable material from hollow bodies, in particular of thrombi and emboli from blood vessels, comprising a working head (11) which is axially displaceable over a guide wire (6) independently thereof and is arranged at the distal end of the catheter and which has at least one lateral opening (14), the catheter (10) having a flexible transport screw (13) which has a distal and a proximal part and is capable of being rotated by means of a rotary drive (2) of a drive unit (1), which rotary drive is a distance away from the working head (11), and comprising a flexible tube (12) surrounding the transport screw (13), connected to the working head (11) and intended for removing the material or the detached thrombi and emboli fragments, and a cutting tool (13), wherein the transport screw (13) is in the form of a shearing cutting tool cooperating with the opening (14) of the working head (11) for comminuting the penetrating materials or aspirated and/or detached thrombi and emboli between the peripheral borders (13a) of the transport screw (13).
2. A catheter for the aspiration, fragmentation and removal of removable material from hollow bodies, in particular of thrombi and emboli from blood vessels, comprising a distal and a proximal end, a working head (11) which is axially displaceable

over a guide wire (6) independently thereof and is arranged at the distal end of the catheter and which has at least one lateral opening (14), the catheter (10) having a flexible transport screw
5 (13) which has a distal and a proximal part, extends from the proximal to the distal end of the catheter and is capable of being rotated by means of a rotary drive (2) of a drive unit (1), which rotary drive is a distance away from the working
10 head (11), the transport screw (13) being provided with transport surfaces which extend helically along its longitudinal axis and in the direction of radii, and comprising a flexible tube (12) surrounding the transport screw (13), connected to the working head (11) and intended for removing
15 the material or the detached thrombi and emboli fragments, and a cutting tool, wherein the transport screw (13) is formed, in the region of the working head (11), as a shearing cutting tool
20 cooperating with the opening (14) of the working head (11), which cutting tool, in the operating state, continuously comminutes the penetrating material or aspirated and/or detached thrombi and emboli between the peripheral borders (13a) of the
25 transport screw (13) and borders of the openings (14) and removes them along the transport surface in the direction of the proximal end (7).

3. A working head on a catheter for the aspiration,
30 fragmentation and removal of removable material from hollow bodies, in particular of thrombi and emboli from blood vessels, which has at least one lateral opening (14), the catheter (10) having a

flexible transport screw (13) which has a distal and a proximal part and can be rotated by means of a rotary drive (2) of a drive unit (1), which rotary drive is a distance away from the working head (11), the transport screw (13) being provided with transport surfaces, and a cutting tool, wherein the transport screw (13) is formed, in the region of the working head (11), as a shearing cutting tool which cooperates with the opening (14) of the working head (11) and, in the operating state, continuously comminutes the penetrating materials or aspirated and/or detached thrombi and emboli between the peripheral borders (13a) of the transport screw (13) and borders of the openings (14) and removes them along the transport surface, and wherein the lateral opening (14) of the working head (11) is in the form of an L-shaped slot (14i, 14k, 14l, 14m) having a limb extending substantially in the longitudinal direction and a limb extending along a part of the circumference.

4. The working head as claimed in claim 3, wherein the ratio of the width of the limb extending in the longitudinal direction to the width of the limb extending in the circumferential direction is from 1.0 to 1.3.
5. The catheter or working head as claimed in any of claims 1 to 4, wherein the distal part of the transport screw (13) in the region of the working head (11) is formed so as to be an exact fit in the external diameter relative to the internal

diameter of the preferably cylindrical working head (11), so that the external diameter of the transport screw (13) has only minimal diameter play relative to the internal diameter of the
5 inner lateral surface of the working head (11).

6. The catheter or working head as claimed in any of claims 1 to 5, wherein the edges on the outside of the transport screw (13) are formed so as to be
10 sharp in the region of the opening (14) of the working head (11).
7. The catheter or working head as claimed in any of the preceding claims, wherein the working head
15 (11) tapers towards its distal end (8).
8. The catheter or working head as claimed in any of the preceding claims, wherein the edges (15) of the lateral opening (14a) are formed so as to be
20 sharp at least in sections in the region of the inner lateral surface of the working head (11).
9. The catheter or working head as claimed in any of the preceding claims, wherein the edges (15) of the lateral opening (14a) are formed so as to be rounded at least in sections in the region of the outer lateral surface of the working head (11a).
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10. The catheter as claimed in any of the preceding claims, wherein the lateral opening (14) is in the form of a slot.
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11. The catheter as claimed in claim 10, wherein the

slot runs at least partially in the axial direction of the working head (11).

12. The catheter as claimed in claim 10 or 11, wherein
5 the slot (14n, 14o, 14p, 14q) is formed, relative to the longitudinal axis of the working head (11n, 11o, 11p, 11q), at least partly along a helix.
13. The catheter or working head as claimed in any of
10 claims 3 to 9 and 11 to 12, wherein the width of the slot (14h) decreases toward the proximal end of the working head (11h).
14. The catheter as claimed in any of claims 10 to 13,
15 wherein the slot (14i, 14k, 14l, 14m) is formed in a L-shape.
15. The catheter or working head as claimed in any of
20 the preceding claims, wherein, in the distal end region of the working head (11b, 11f, 11g, 11q) at least one groove-like recess (19a, 19b, 19c) starting from the distal end and opening in to the lateral opening (14b, 14f, 14g, 14q) is arranged on the outer lateral surface.
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16. The catheter or working head as claimed in claim 15, wherein the depth of the groove-like recess (19) increases toward the proximal end of the working head.
17. The catheter or working head as claimed in claim 15 or 16, wherein the width (b) of the groove-like recess (19b) is greater than the chord (s) of the

internal diameter of the working head (11f) in the region of the groove base.

18. The catheter or working head as claimed in any of
5 the preceding claims, wherein the working head (11a) is connected to the tube (12) axially in a manner resistant to tension and pressure.
19. The catheter as claimed in any of the preceding
10 claims, wherein the tube (12) has a reinforcement (17) at least in sections.
20. The catheter as claimed in claim 19, wherein the reinforcement (17) is in the form of a metallic helix.
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21. The catheter as claimed in claim 19 or 20, wherein the reinforcement (17) is arranged on the inside of the tube (12).
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22. The catheter as claimed in any of the abovementioned claims, wherein the tube (12) is formed in two parts, the proximal part being in the form of a plastic tube and the distal part
25 being in the form of a metallic helical spring (17) having a thin-walled elastic plastic sheath (18).
23. The catheter or working head as claimed in any of the abovementioned claims, wherein the working head (11) and/or the transport screw (13) consist
30 of metal, in particular of stainless steel.

24. The catheter or working head as claimed in any of the above mentioned claims, wherein the working head (11) is composed of sintered ceramic or metal ceramic or has a highly resistant layer for protection from wear.
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25. The working head for a catheter as claimed in any of the abovementioned claims, according to one of fig. 4 to 80.